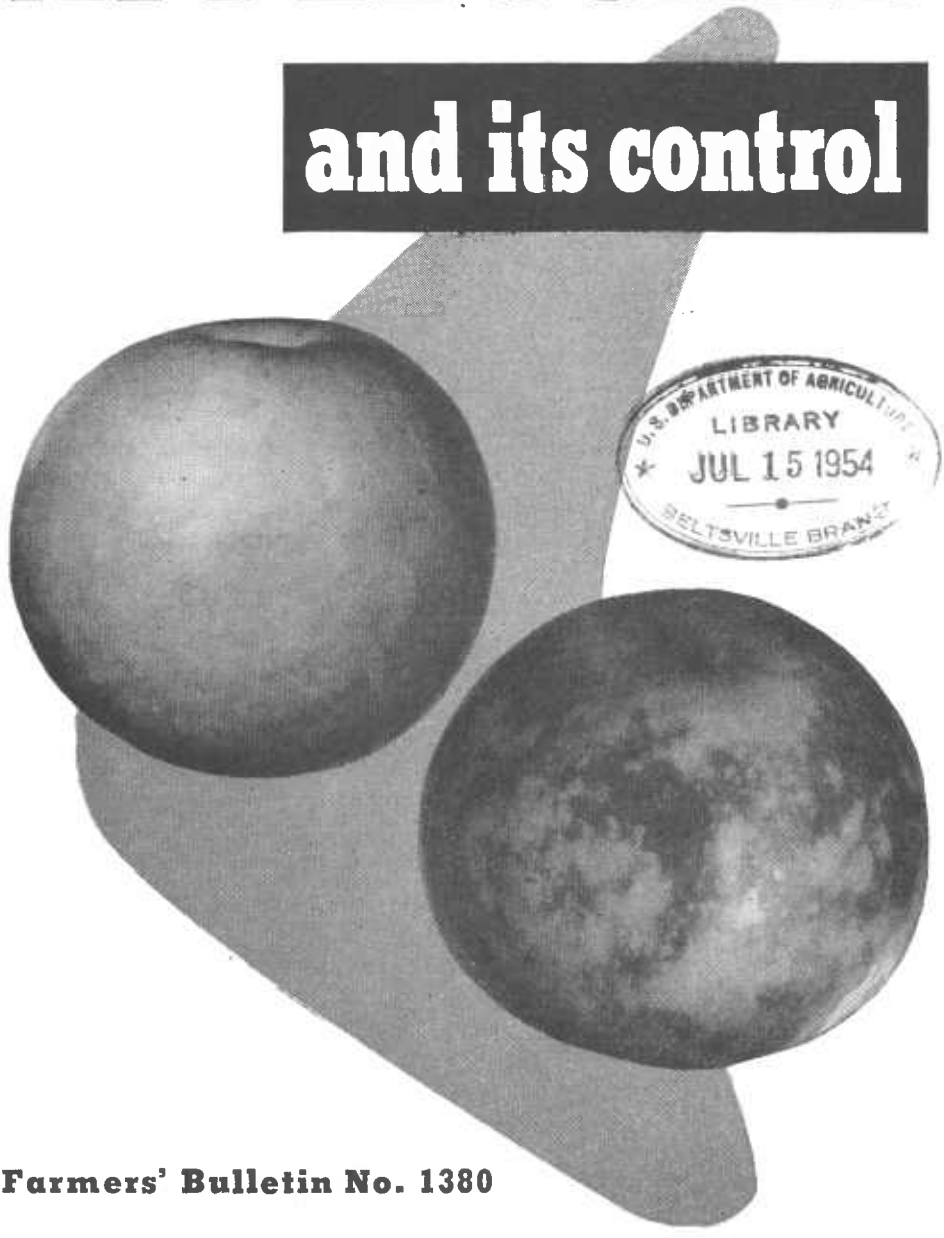
# APPLE SCALD

## and its control





**Farmers' Bulletin No. 1380**

U. S. DEPARTMENT OF AGRICULTURE

## To Prevent Apple Scald

1. Store only mature, well-colored fruit.
2. Store fruit at 30° to 31° F.
3. When it is impossible to store fruit immediately after harvest, keep it in the shade and give it free exposure to the air.
4. Wrap fruit in oiled (not waxed) paper at harvest or within not more than 1 to 2 months after harvest. Or scatter one-half pound of shredded oiled paper per bushel throughout packages of nonwrapped fruit.
5. Use well-ventilated packages and stack so that air can circulate freely. This is particularly important when the apples are stored loose for packing as sold. High humidity (90 to 95 percent) should be maintained under these conditions to prevent shriveling.
6. Market apples before scald develops (usually within 60 to 90 days after harvest for susceptible varieties if not protected by oiled paper).
7. Keep apples under refrigeration after they leave storage. This will not only retard scald development but will maintain the fruit in a crisp, juicy condition.

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## Contents



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# Apple Scald and Its Control

By M. H. Haller, *senior horticulturist, Biological Sciences Branch, Agricultural Marketing Service* [1]

## Importance of Scald Control

Scald was one of the most serious storage and market diseases of most varieties of apples previous to the early 1920's. It is now of much less commercial importance, because of the rather general use of the oiled-paper method of control discovered and recommended by the United States Department of Agriculture. Even when oiled paper is used, however, scald still may become serious late in the storage season on apples of susceptible varieties, particularly if they are picked early or when not enough oiled paper is used.

Scald may appear on fruit from any apple-producing district. Varieties differ widely in susceptibility to scald, but none is immune. Among the most susceptible varieties are Grimes Golden, Stayman Winesap, Arkansas (Black Twig), Rome Beauty, Cortland, and York Imperial. Scald rarely develops seriously on Jonathan, McIntosh, or Golden Delicious. Other commercially important varieties are intermediate in susceptibility.

Scald may show up on apples not in oiled paper 60 to 150 days after harvest and while they are still in commercial storage. It develops, however, most rapidly on fruit that has been removed from storage to the warmer air of the market and the home. When removed from storage, the apples may appear to be in good condition, but a few days later their market value may be greatly reduced because of scald. A disease that develops rapidly when the apples are ready for eating, scald causes heavy losses, limits distribution, and decreases consumption.

## Symptoms and Cause of Scald

In mild cases of scald small areas of the surface on the unblushed side are lightly tinted with brown and the skin remains firm; in more severe cases larger areas of the surface become dark brown and slightly depressed. In some instances the browning extends into the flesh a short distance. Then, the disease takes on an appearance similar to that of a rot; but true rot usually spreads more or less conically into the flesh, whereas

[1] Original bulletin was written by Charles Brooks, formerly principal pathologist, D. F. Fisher, formerly principal horticulturist, and J. S. Cooley, formerly senior pathologist, Horticultural Crops Research Branch, Agricultural Research Service.

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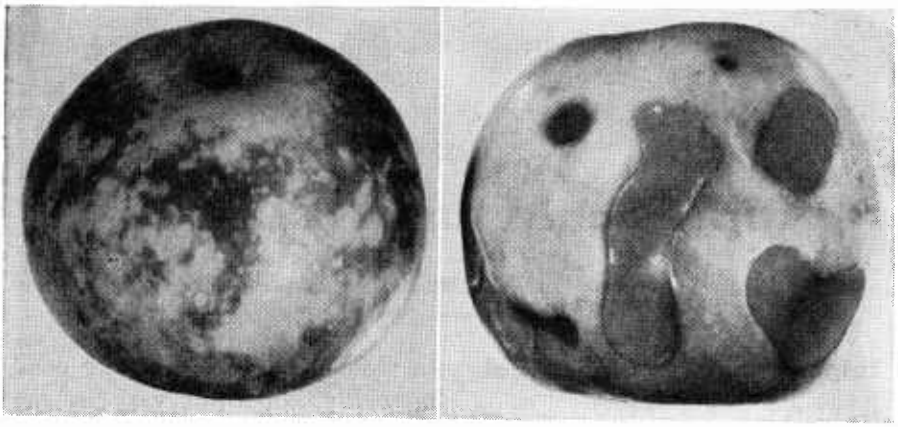

FIGURE 1.—*Apple scald, on the left, showing the characteristic distribution of the browning over the skin of the apple. Soft scald, on the right, shows the characteristic pattern of discoloration and the resulting sunken areas.*

scald affects a considerable area of the apple to a rather uniform but shallow depth. Decayed tissue is usually softer and more watery than scalded tissue. When severe, scald kills the skin; organisms causing decay readily invade this dead tissue and soon destroy the entire apple.

Unlike the rots, scald is not caused by molds or bacteria. It is considered to be an injury from an accumulation in the skin or waxy coating of apples of some gaseous substance given off by the fruit during storage. Partial removal of the wax after a period of storage has been shown to reduce the tendency of apples to scald.

Scald is sometimes confused with soft scald (fig. 1). The similarity of the names commonly used for these two distinct storage disorders adds to the confusion. Soft scald usually appears in well-marked patterns. Often it occurs in bands with sharp edges. Eventually the skin becomes depressed but tightly drawn over the affected areas. The apples look as though they had been rolled over a hot stove. Soft scald appears on the apples while they are still in cold storage, but it is seldom seen before mid-December. The first symptoms are fading and diffusion of the red pigments in the skin; browning of the surface and underlying flesh tissue follows, with the browning becoming progressively worse. Soft scald is most commonly found in Jonathan and Rome Beauty, but Winesap and Delicious are sometimes affected. Unlike scald, it cannot be controlled by use of oiled paper. The most practicable means of preventing loss from soft scald is to store the apples at a temperature of about 36° instead of 30° to 31° F.

## Effect of Orchard Conditions on Apple Scald

### Maturity of Apples

The maturity of apples at picking time is important in determining their susceptibility to scald. Much less scald develops on well-

matured apples picked late in the season than on apples that are picked early in the season when less mature.[2]

### Size of Apples

In general, large apples are more susceptible to scald than small ones, but this difference in susceptibility is apparently caused not so much by size in itself as by the forcing that induces large size and the poor color that usually accompanies forcing. Apples may grow to good size without becoming unduly susceptible to scald if left on the trees long enough to mature properly and develop good red color.

### Color of Apples

Scald differs from all other apple diseases in developing mainly on the green or unblushed parts of the fruit. Bright-red areas on mature fruit are highly resistant to scald, and yellow areas are much more resistant than those that are green or that show the first stages of turning from green to yellow. Color is influenced by weather, pruning, soil fertilizer, and general orchard management, as well as by time of picking. Good exposure to sunlight produces high color and makes apples more resistant.

The red bud sports of Delicious, Stayman Winesap, Rome Beauty, and other varieties color well before they are mature enough to develop resistance; consequently, they may be affected by scald if harvested before they reach the proper stage of maturity, even though well colored. To hold scald to a minimum on red bud sports, as well as on other apples, it is essential to let the fruit fully mature before harvesting.

### Soil Fertilization

Applications of nitrogenous fertilizers retard yellowing of the fruit. However, investigations have not shown any consistent effect of soil nitrogen on the development of scald.

Soil applications of boron reduce susceptibility to scald under conditions where boron is not so seriously deficient as to cause internal cork. However, excess boron may be harmful to some varieties (particularly Jonathan), and care is needed in its use.

### Soil Moisture

The effect of soil moisture on the susceptibility of the fruit to scald is most noticeable under irrigation conditions, but it is often observed also in fruit from nonirrigated trees. Apples from heavily irrigated trees or from trees that have received heavy late rainfall often develop much more scald, both while in storage and after removal from storage, than those from lightly irrigated trees or from trees that do not receive late rainfall.

### Other Factors

Susceptibility to scald may also be influenced by other orchard conditions. It has been reported that high temperatures during the 6 weeks before harvest increases susceptibility to scald.

[2] For information relative to determination of proper maturity at which to pick, see U. S. Department of Agriculture Technical Bulletin 1003, Evaluation of Indexes of Maturity for Apples.

Many new insecticides, fungicides, and growth regulators have been introduced in recent years. Postharvest applications of certain growth regulators have been shown to reduce scald. (See p. 7.) Their use as preharvest sprays might also have an effect. However, as preharvest sprays, they are used in much weaker concentrations. There has been some indication that the use of Captan (Orthocide 406) as a fungicide in the cover sprays may reduce scald during storage.

## Effect of Packinghouse, Storage, and Transportation Conditions on Apple Scald

Although orchard and seasonal conditions are important in influencing the susceptibility of the fruit to scald, the conditions that prevail after apples are picked decide the extent to which scald will develop.

### Temperature

Scald does not develop on apples ripened at room temperature (65° F. and above) immediately after picking.

Holding apples at prevailing outside temperatures for short periods previous to storage has sometimes reduced susceptibility to scald during storage, particularly if the apples are well aerated during the holding period. Such holding would hasten the ripening of the fruit and thus tend to shorten its storage life.

Within the range of cold storage temperatures (30° to 40° F.) at which scald does occur, the time of its appearance is delayed as the temperature of storage is lowered. It is important, therefore, that apples of scald-susceptible varieties be stored at the lowest practical temperature (30° to 31° F.) and that the cooling be rapid and exposure to the intermediate temperatures as short as possible. Although low temperature retards scald, the fruit eventually may develop as much scald following low-temperature storage as at somewhat higher storage temperatures. Before actual browning of the fruit occurs at cold-storage temperatures, the apples develop a potentiality for scald. Scald then develops very rapidly when the fruit is removed from storage to temperatures usual in stores and homes. Therefore, it is desirable from time to time to remove samples from storage to room temperatures to find out whether a given lot of apples is developing a tendency to scald. From 1 to 3 days at room temperature is usually long enough to allow scald to develop in susceptible fruit.

It is desirable to hold apples at low temperatures (45° to 50° F.) after storage. These temperatures retard scald development much longer than room temperatures of 70° or above do.

### Aeration and Ventilation

Free circulation of air around the fruit to remove the volatile material from around the surface of the fruit is one means of reducing scald. This becomes even more effective if fresh air replaces the air laden with the volatile materials (ventilation). Leakage and the normal opening and closing of the storage-room doors in moving fruit in and out of

the rooms, checking of temperatures, and other activities usually result in considerable changing of the air.

Forced ventilation with large quantities of fresh air does not appear feasible because of difficulties in controlling temperature and humidity. Using packages that are well ventilated and stacking the packages so there can be good circulation of air around them tends to reduce scald by permitting the more rapid removal of volatile materials from around the fruit.

Some growers store apples in field crates. These apples are graded later during the winter and packed in shipping containers or prepackaged. When this is done, the use of oiled paper previous to packaging is not practical, and control of scald must depend largely on effective circulation of the air.

Facilitating the free circulation of air around the fruit would tend to increase the rate of moisture loss from the fruit, which would hasten shriveling. Increasing air circulation around apples that are more subject to shriveling than to scald (such as Golden Delicious) would not be desirable. Where air circulation is used to reduce scald it is important that a high humidity (at least 90 percent) be maintained to lessen shriveling.

Controlled-atmosphere storage in which the storage rooms are made airtight and kept closed to permit the accumulation of carbon dioxide evolved by the fruit also permits the accumulation of the material causing scald. Consequently, scald is likely to be severe under controlled-atmosphere conditions.

## Scald Control by Use of Oiled Paper

The most efficient and practical method of controlling scald now known is the use of oiled paper (not wax paper). Oiled wrappers do not always completely control scald, but they prolong the storage life of the fruit so that it can be marketed later in the season. This is particularly true for apples grown in the Pacific Northwest where wrappers are generally used and where most of the varieties grown are fairly resistant to scald. In the Central and Eastern States most apples are packed in baskets, and shredded oiled paper is used instead of wrappers. In these regions a large proportion of the apples are of varieties that are susceptible to scald, and sometimes the oiled paper is not effective. Sometimes most of the scald injury—even in a susceptible variety—can be prevented by use of oiled-paper wrappers, as shown in figure 2.

Oiled paper not only delays the development of the disease on the fruit but also reduces the tendency to scald. Usually less scald develops on apples in oiled paper toward the end of the storage season than on unwrapped fruit months earlier.

Oiled paper is most effective where the apples are packed in it soon after harvest. Little or no control can be expected if the packing in oiled paper is delayed 6 to 8 weeks or more.

The oiled paper must carry at least 15 percent of its finished weight in odorless, tasteless mineral oil if it is to give satisfactory


FIGURE 2.—*Grimes Golden apples in oiled and unoiled wrappers, removed from cold storage at Wenatchee, Wash., February 13 and photographed March 1.*

scald control, and 18 to 20 percent of oil gives better control.

If the apples are not wrapped in oiled paper, shredded oiled paper is scattered through the package. Shredded oiled paper is cut so that it can be readily scattered in the package. The strips are usually about 5 inches long and three-eighths of an inch wide. For use in shredded form a paper that is somewhat resilient and springy is better than one that is soft and inclined to mat. Such paper is easier to shake apart after it has been baled, and when thrown into the package it has a greater tendency to spread out between the apples and give maximum contact with them.

If the paper is evenly distributed, half a pound to the bushel is usually sufficient to give satisfactory scald control; but three-quarters of a pound gives better results with susceptible varieties. In any event, the shredded oiled paper should be well distributed among the apples in the package. The use of a handful only on top of the package for decorative purposes is of no value in scald control.

## Other Methods of Scald Control

Since the oiled-paper method of scald control was discovered and introduced in the early 1920's, oiled paper in wrapper or in shredded form has continued to be the most practicable means of scald control. Certain other methods, however, have been tried under experimental conditions and may ultimately prove to be practicable commercially. As yet, none of them is used widely. Included in the newer experimental methods are the following:

*Air purification with activated charcoal.*—Circulating the storage

air through activated coconut-shell charcoal to remove the volatile substances given off by the apples was originally reported to reduce scald. Many of the subsequent investigations have shown little or no scald control by this method. Because of the inconsistent results under experimental conditions, this method is not recommended as a practical means of controlling scald.

*Carbon dioxide treatment.*—Holding the apples in high concentrations of carbon dioxide for a few days before placing them in cold storage or for a few weeks in cold storage reduces scald appreciably. This treatment has not been adopted commercially.

*Growth regulators.*—Treatment with certain chemicals that regulate growth and physiological activity of plants has been found to reduce scald. One of these, *a*-naphthaleneacetic acid supplied with emulsified lanolin, is as effective as oiled paper with certain varieties and under certain conditions of maturity; with other varieties and conditions it is not so effective as oiled paper.

*Waxing.*—Application of certain waxes gives some reduction in scald, but the control is usually less than is obtained with oiled paper.

All of these methods avoid the necessity of wrapping the apples or of packing them in shredded oiled paper. Doubtless they would be regarded with favor for that reason, particularly in retail markets where the fruit is placed on display and the labor of removing the paper is an item to be considered. No definite statement as to comparative costs involved in the different methods can be made, but regardless of the method used it is certain that the cost of scald control will be less than the loss on untreated apples.

## Critical Periods in Scald Control

With reference to the development of scald, the life of stored apples may be divided into four periods, or stages. These periods will vary greatly, depending on variety and climatic and cultural conditions. The approximate range for each follows:

The first period is the first 6 to 8 weeks in cold storage. During this time the scald-producing factors are apparently most active; yet, preventive treatments applied up to the end of the period will largely overcome the tendency to the disease. Apples removed from storage during this time do not develop scald at room temperature.

During the second period in the development of scald the apples can be removed from storage and held at room temperature with little or no scald developing, even when no oiled paper is used. However, preventive measures applied at this time will be much less effective or may be ineffective, so that scald may develop in the apples when they are held beyond this period if preventive treatment has been delayed this long. This period extends from about the sixth to the twelfth week in cold storage.

During the third period the apples are free of scald symptoms while in cold storage, but they have developed a tendency to scald, so

that when removed to a warm room susceptible apples soon become scalded. This period may last for 4 to 8 weeks between the tenth and twentieth week in storage. During this time it is particularly important that samples be removed from storage at intervals to determine the tendency of the fruit to scald at room temperature.

During the fourth period of scald development the apples gradually become scalded while in storage. When removed from storage the scald rapidly becomes more severe by covering more surface, becoming darker brown, and by penetrating below the skin. This period may begin after only 10 or 12 weeks in the Grimes Golden variety or after 16 to 20 weeks with late storage varieties.

These periods occur whether the apples are packed in oiled paper or not, but are later and the scald less severe when oiled paper is used and when the apples were well matured when picked.

### After-Storage Behavior of Apples With Scald

If the storage rooms are opened but little and the temperature is held constantly at 30° to 31° F., scald may not become evident until the apples are removed from storage. Such delays in the appearance of scald have often resulted in serious disputes over responsibility for its occurrence and accountability for scald losses. The rate of scald development after removal of the apples from storage will depend upon the temperature to which the fruit is exposed. During the winter months, when temperatures are low, apples are often passed on to the consumer before scald becomes seriously evident; but during the late spring months, when temperatures may be high, the disease is likely to develop in transit or on the market.

### Losses From Scald

Before the use of oiled paper became general, market-inspection reports showed that apple scald was a close second to blue mold in causing loss during storage. The use of oiled paper has made it possible to prolong greatly the storage life of many varieties. However, with such susceptible varieties as York Imperial, Arkansas (Black Twig), and Stayman Winesap, scald development is still the principal factor limiting their storage life.

If dealers discover too many apples with scald are appearing on the market, the shipper may find it difficult to sell his apples or he may have to take a discount. The lower price is not the result entirely of the bad condition of the fruit at the time of sale. The dealer knows that he cannot hold the fruit long for more favorable prices and usually has to sell it for what it will bring. Losses and spoilage from scald vary with the season, the locality, and the size of the crop. More scald is evident in southern than in northern markets, more during warm periods than during cool ones, and more in years when the fruit moves slowly than when there is a ready sale.

If too many apples develop scald in the hands of the consumer, he

usually stops buying the fruit for a while. This is a distinct handicap to the apple industry in disposing of fruit in cold storage.

Although the general use of oiled paper since the 1920's has greatly reduced the losses caused by scald, these losses are still sometimes rather severe. Oiled paper does not give complete control in seasons favorable to scald if the fruit has been picked before reaching proper maturity, if the packer does not use enough oiled paper, or if apples are held beyond their normal storage season.



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# PREVENT FARM FIRES

Fires kill more than 3,000 farm people each year, and cause painful injury to many thousands more.

In farm homes fire is the main cause of death and injury among younger people.

Each year fires destroy $133,000,000 worth of farm property.

Much of this loss and suffering can be avoided by taking precautions to prevent fires or by being prepared to control those that do get started. In making a fire-safety check on your own farm, keep in mind that the primary causes of farm fires are—

- Lightning
- Sparks on the roof
- Defective chimneys or heating systems
- Faulty electric wiring or appliances
- Careless smokers
- Careless use or storage of gasoline, kerosene, oily rags, and such
- Children playing with matches

Don't start any fire unless you know you can stop it.

Keep a fire extinguisher handy and make sure every member of the family knows how to use it.

*For details, see U. S. Department of Agriculture Farmers' Bulletin No. 1643, Fire Safeguards for the Farm.*